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Forest Health Protection Report

Forest Insect and Disease Conditions in Alaska - 2000

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FOREST INSECT AND DISEASE CONDITIONS IN ALASKA - 2000

General Technical Report R10-TP-86

January, 2001

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CONDITIONS IN BRIEF

Aerial detection mapping is conducted annually to document the location and extent of active forest insect and disease damage. These surveys generally cover approximately 1/3 of the forested land in Alaska. Smoke from large wildfires in interior Alaska and inclement weather precluded flights into many areas of concern. Even so, over 27 million acres throughout Alaska were surveyed. This is the second year of overall decreased insect activity; although, areas not often affected by insect damage such as Sleetmute or Elim, did have insect damage reported. The most important diseases and declines in Alaska are characterized as chronic conditions and remain relatively unchanged.

INSECTS:

Total area of active **Spruce Beetle** infestation decreased in 2000 to only 86,038 acres, continuing the decline in mapped acreage, which began in 1997. In areas which have recently been heavily impacted, such as Iliamna Lake, the Copper River Valley, the west side of Cook Inlet, the Anchorage Bowl, the northern Kenai Peninsula and the eastern portion of Kachemak Bay, population levels have declined dramatically due to lack of host material (i.e., the beetles have run out of live spruce trees to attack). Some active areas persist, where suitable host material remains or where new areas of disturbance present the spruce beetle with fresh opportunities for population increases. Heavy activity continues near Lake Clark along the Tlikakila River and in the Hanagita River Valley in the Wrangell-St. Elias National Park and Preserve. Spruce Beetle activity was identified in two new areas. One active area was around the community of Sleetmute and the other near Elim on Norton Sound.

Spruce beetle activity in southeast Alaska was at a low of 2700 acres from a high of 35,700 acres in 1996 and 6,556 acres in 1999. Much of this activity was in the Chilkat and Chilkoot drainages near the Canadian border. There were only 200 acres of activity in Glacier Bay National Park east of Gustavus and 100 acres on the outer islands west of Prince of Wales Island. No new acres were infested along the Taku River near the Canadian border.

Spruce needle aphid defoliation occurred on approximately 36,000 acres in southeast Alaska from Cape Decision, at the southern tip of Kuiu Island, to Yakutat Bay. Most of the defoliation was located in the Juneau area and a few miles to the northwest of Juneau in Glacier Bay National Park. A smaller amount of defoliation was distributed along the western half of Baranof and Chichagof Islands. Sitka spruce were affected along the beach fringe and higher on mountain slopes.

Spruce budworm activity, along the Yukon River, appears to have collapsed. Although, an area of white spruce, approximately 41,000 acres, north of Fort Yukon on the Christian River was lightly defoliated. The cause is not known but could be spruce budworm or spruce bud moth.

Willow leaf blotchminer defoliation continued for the third consecutive year; nearly 35,000 acres of defoliated willow were aerially detected in 2000. In the last two years, most of the willow defoliation was located in the upper Yukon and Porcupine River valleys; this year, blotchminer defoliation was found as far west and south as McGrath. Mortality of willow is occurring in interior Alaska.

Large Aspen Tortrix defoliation continued its decline in 2000, with 5,576 acres mapped. **Aspen Leaf Miner** was also prevalent throughout interior Alaska.

Larch sawfly continues to be active throughout the range of larch in interior Alaska. Defoliation, however, was significantly reduced over 1999 levels. Approximately 65,000 acres of defoliated larch were detected this year vs. more than 190,000 acres of defoliated larch in 1999. In many of the previously defoliated areas, patches of larch mortality are beginning to appear; either due to the direct effects of the sawfly or by the larch beetle attacking stressed, defoliated trees. The major area of sawfly activity continues to be from the Alaska Range west to the Kuskokwim River. Larch sawfly was once again reported in the Mat-Su Valley and Anchorage Bowl areas defoliating ornamental larch. This was no doubt an accidental introduction.

Hemlock sawfly defoliated approximately 5,200 acres in southeast Alaska concentrated in Kasaan Bay, Prince of Wales Island, Burroughs Bay north of Ketchikan, and Windham Bay east of Admiralty Island.

DISEASES:

The most important diseases and declines of Alaskan forests in 2000 were wood decay of live trees, root disease of white spruce, hemlock dwarf mistletoe, and yellow-cedar decline. Except for yellow-cedar decline, trees affected by these diseases are difficult to detect by aerial surveys. Nonetheless, all are chronic factors that significantly influence the commercial value of the timber resource and alter key ecological processes including forest structure, composition, and succession. Wildlife habitat is enhanced through the development of hollow tree cavities by heart rot fungi, and witches' brooms by hemlock dwarf mistletoe and broom rust fungi.

In southeast Alaska, approximately one-third of the gross volume of forests is defective due to **stem** and **butt rot fungi**. **Hemlock dwarf mistletoe** continues to cause growth loss, top-kill, and mortality in old-growth forests; its impact in managed stands depends on the abundance of large infected trees remaining on site after harvesting.

Approximately 500,000 acres of **yellow-cedar decline** have been mapped across an extensive portion of southeast Alaska. Snags of yellow-cedar accumulate on affected sites and forest composition is substantially altered as yellow-cedar trees die, giving way to other tree species. The wood in dead standing trees remains valuable long after tree death and salvage opportunities for this valuable resource are now being recognized.

In south-central and interior Alaska, **tomentosus root rot** continues to cause growth loss and mortality of white spruce in all age classes. Stem, butt, and root rot fungi cause considerable defect in white spruce, paper birch and aspen stands. Saprophytic decay of spruce bark beetle-killed trees, primarily caused by the **red belt fungus**, continues to rapidly develop on and degrade dead spruce trees.

Spruce needle rust occurred at high levels in several areas of southeast Alaska for the second consecutive year. Cone and other foliar diseases of conifers were generally at low levels throughout Alaska in 2000. Canker fungi were at endemic levels, causing substantial, but unmeasured, damage to hardwood species in south-central and interior Alaska.

Other:

Three specific introduced pests are causing concern in the Anchorage area. The **Sitka spruce weevil** and the **European black slug** may become established in Alaska if detection and eradication methods are not employed early. **Bird vetch**, *Vicca cracca,* has been observed as an aggressive plant invader along portions of the Seward highway in South Anchorage. It has been spotted along trails in Chugach State Park and on sites in the Hillside neighborhoods.

In localized areas of southeast Alaska, feeding by **porcupines** and **brown bears** continues to cause tree damage to several conifer species.

Table 1. 2000 forest insect and disease activity as detected during aerial surveys in Alaska by land ownership[1] and agent[2]. All values are in acres.

Damage Agent	State & Private	National Forest	Other Federal	Native Corp.	Total 2000	*Change From 1999*
Alder Defoliation[3]	147	5,161	261	0	5,570	3,755
Aspen Defoliation[3]	3,788	0	2,076	1,103	6,967	6,967
Birch Defoliation[3]	461	0	2,160	4	2,625	-128
Blowdown/Windthrow	55	267	0	0	322	-75
Cottonwood Defoliation[4]	205	5,185	0	0	5,389	-201
Engraver Beetle[5]	4,715	0	17,565	667	22,947	19,169
Hemlock Sawfly	264	4,552	0	292	5,108	5,019
Landslide / Avalanche	286	615	27	30	957	882
Larch Sawfly	3,839	0	41,993	19,028	64,859	-94,401
Large Aspen Tortrix	1,991	0	2,107	1,479	5,576	-7,760
Porcupine Damage	0	398	10	0	407	62
Spruce Aphid	9,124	22,390	5,325	733	37,572	33,319
Spruce Beetle	32,011	1,867	32,958	19,202	86,038	-167,227
Spruce Budworm	0	0	12,556	28,511	41,066	40,358
Water Damage	317	67	55	13	452	-2,120
Willow Defoliation[3]	6,489	0	16,171	13,343	36,002	-144,394
Total Acres	**63,692**	**40,502**	**133,264**	**84,405**	**321,857**	**-306,775**

[1]ownership derived from 1999 version of Land Status GIS coverage, state of AK, DNR/Land records Information Section

[2] Table entries do not include many of the most destructive diseases (e.g., wood decays and dwarf mistletoe) because these losses are not detectable in aerial surveys. Cedar decline acres can be seen in table 7.

[3]significant contributors include leaf miners and leaf rollers for the respective host

[4]significant contributors include cottonwood leaf beetle and leaf rollers

[5]includes acres where both engraver beetle and spruce beetle infested the same area

Table 2. Acreage having active insect damage, by year, since 1995, and the cumulative area (in thousands of acres) affected for the last 6 years.

Damage Agent	1995 Total	1996 Total	1997 Total	1998 Total	1999 Total	2000 Total	Cumulative Totals[1]
Spruce beetle	893.9	1,133.0	563.7	316.8	253.3	86.0	**2046.3**
Larch sawfly	116.9	606.9	267.6	461.8	159.3	64.9	**1544.6**
Spruce budworm	279.3	235.9	38.4	87.8	0.7	41.1	**501.0**
Willow defoliation	5.6	50.1	3.5	123.1	180.4	36.0	**338.5**
Birch defoliation[2]	0.9	3.2	271.9	0.5	2.8	2.6	**280.4**
Spruce aphid	0.1	0.5	0.5	46.4	4.3	37.6	**88.6**
Large aspen tortrix	32.4	6.4	5.1	21.8	13.3	5.6	**81.9**
Engravers[3]	6.7	14.2	8.9	14.3	3.9	23.0	**70.1**
Black-headed budworm	13.0	1.2	30.8	--	--	--	**44.9**
Cottonwood defoliation[4]	3.5	5.4	3.0	6.6	5.6	5.4	**29.3**
Hemlock sawfly	1.1	8.3	6.6	3.9	--	5.1	**25.2**
Total thousands acres	**1353.4**	**2065.1**	**1200.0**	**1083.0**	**623.6**	**307.3**	**5050.8**

[1] The same stand can have active infestation for several years. The cumulative total is a union of all areas for 1995 through 2000.

[2] Tallies represent polygons coded to BID (birch defoliation), BAP (birch aphid) and BLR (birch leaf roller).

[3] Tallies represent polygons coded to ipb (*Ips* and spruce beetle combination) and polygons coded only to IPS.

[4] Tallies represent polygons coded to CWD (cottonwood defoliation), CLB (cottonwood leaf beetle) and CLM (cottonwood leaf miner).

THE ROLE OF DISTURBANCE IN ECOSYSTEM MANAGEMENT

To the casual observer, forests may appear to be unchanging. In fact, most forests are in some stage of re-establishment after one or more disturbances. In Alaska, geological processes, climatic forces, insects, plant diseases, and the activities of animals and humans have shaped forests. To practice ecosystem management, we must understand how these cycles of disturbances have shaped and continue to influence various forest ecosystems.

Disturbances result in changes to ecosystem function. In forests, this often means the death or removal of trees. Disturbances caused by physical forces such as volcanoes, earthquakes, storms, droughts, and fire can affect the entire plant community, although some species may be more resistant to damage than others. Insects, plant diseases, animal and human activities are usually more selective, directly affecting one or several species.

Figure 1. Fire is a frequent and dramatic form of disturbance in interior Alaska.

Cycles of disturbance and recovery repeat over time and across landscapes. From evidence of past disturbances on a landscape, we can predict what type of disturbance is likely to occur in the future. Landscapes supporting large areas of single age stands indicate rare, but intense large-scale disturbances. Landscapes with a variety of age classes and species suggest more frequent smaller scale events. Usually, several types of disturbances at various scales of space, time, and intensity have influenced forest structure and composition on a given site. The role of disturbance in ecological processes is well illustrated in Alaska's two distinct forest ecosystem types and transition zones.

The temperate rain forests of southeast Alaska are dominated by western hemlock and Sitka spruce. Alaskan yellow-cedar, western red cedar, shore pine and mountain hemlock are also important components. Trees on productive sites can attain great size due to abundant rainfall and moderate temperatures. Wind is the major disturbance agent in southeast. Degree of impact and scale depends on stand composition, structure, age and vigor and as well as wind speed, direction, duration and topographic effects on wind flow. The forest type most susceptible to wind throw is mature spruce-hemlock on productive, wind-exposed sites. The large, top-heavy canopies act as sails and uprooting is common, resulting in soil churning, which expedites nutrient cycling and increases soil permeability. Even-aged forests develop following large-scale catastrophic wind events. Old-growth forest structure develops in landscapes protected from prevailing winds. In these areas, small gap-forming events dominate. Trees are long-lived, but become heavily infected with heart-rot fungi, hemlock dwarf mistletoe, and root rot fungi as they age. Weakened trees commonly break under the stress of gravity and snow loading. Canopy gaps generated this way do not often result in exposed mineral soil.

The boreal forests of interior Alaska are comprised of white spruce, black spruce, birch, aspen and poplar. The climate is characterized by long, cold winters, short, hot summers, and low precipitation. Cold soils and permafrost limit nutrient cycling and root growth. Topographic features strongly influence microsite conditions; north-facing slopes have wet, cold soils, whereas south-facing slopes are warm and well drained during the growing season. Soils are usually free from permafrost along river drainages, where flooding is common. Areas more distant from rivers are usually underlain by permafrost and are poorly drained. Fire is the major large-scale disturbance agent; lightening strikes are very common. All tree species are susceptible to damage by fire, and all are adapted, to various degrees, to regeneration following fire. Fire impacts go beyond removal of vegetation; depending on the intensity and duration of a fire, soil may be warmed, upper layers of permafrost may thaw, and nutrient cycling may accelerate. Patterns of forest type development across the landscape are defined by the basic silvics of the species involved. Hardwoods are seral pioneers, re-sprouting from roots or stumps. White spruce stands are usually found on better-drained soils, along flood plains, river terraces, and on slopes with southern exposure. Black spruce and tamarack occur in areas of poor drainage, on north-facing slopes, or on upland slopes more distant from rivers where permafrost is common.

South-central Alaska is a transition zone between the coastal marine climate of southeast and the continental climate of the interior. These forest communities are more similar to those in the interior, except where Sitka spruce and white spruce ranges overlap and the Lutz spruce hybrid is common. Fire has been a factor in the forest landscape patterns we see today. These fires, however, were mostly the result of human activity; lightning strikes are uncommon in the Cook Inlet area. Major disturbances affecting these forests in the past century have been human activity and spruce beetle caused mortality. Earthquakes, volcanic eruptions, and flooding following storm events have also left significant signatures on the landscape.

Disturbances play an important role in shaping forest composition, structure, and development. With knowledge of disturbance regimes, managers can understand key processes driving forest dynamics and gain insight into the resiliency (the ability to recover) and resistance (the ability to withstand change) of forests to future disturbance. As we improve our understanding of the complexities of these relationships, we are better able to anticipate and respond to natural disturbances and mimic the desirable effects with management activities. Ecological classification is one tool available to help us understand disturbance patterns.

Several useful systems of classification have been developed for Alaska's ecosystems and vegetation. Efforts to refine and standardize these classifications across all ownerships produced a unified map in 2000. Field and resource specialists representing a variety of organizations, including representatives from Canada, came together to evaluate two existing maps (Gallant et al. 1995 and Nowacki and Brock 1995) along with additional resource information. Line placement was refined using the best available data. Delineation criteria ultimately included climate, phsyiography, vegetation, and glaciation.

In Alaska, three distinct climatic-vegetation regimes exist representing polar, boreal, and maritime. These regimes cover broad areas and grade from one to another across the state. To accommodate this spatial arrangement, ecoregion groups were arranged in a triangular manner reflecting the major regimes and gradations between them (Figure 2). Through this projection (a tri-archy), the natural associations among ecoregion groups are displayed as they occur on the land without loss of information (i.e., retains the spatial interrelations of the groups).

Throughout this report, we make reference to the Ecoregions of Alaska (see map on following page). Brief Ecoregion descriptions are included in Appendix D.

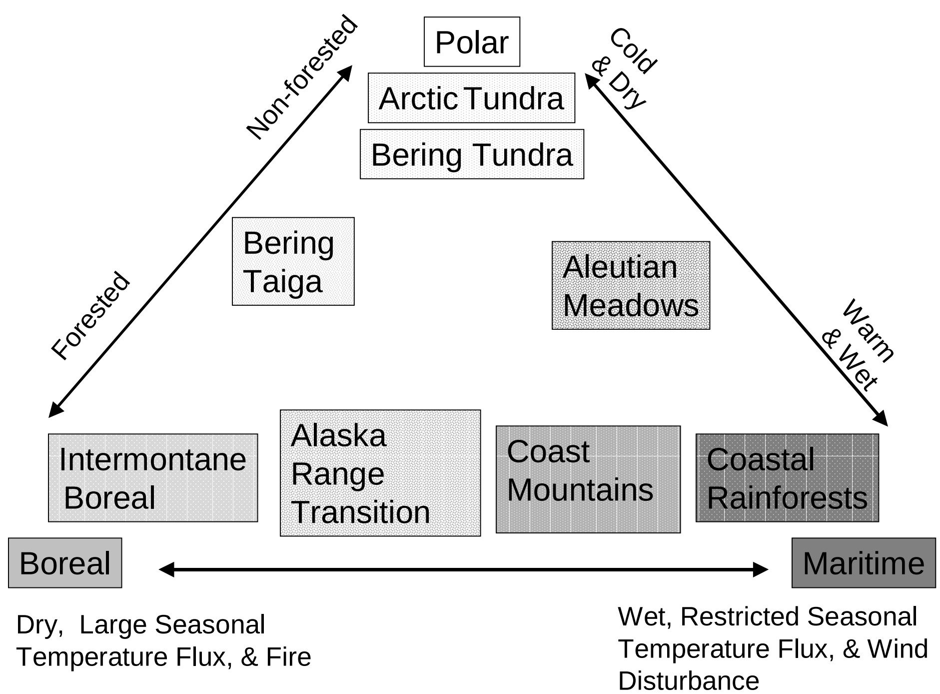

Figure 2. This tri-archy illustrates the major regimes and gradations between the Alaska ecoregions.

Table 3. Frequency (number of years between 1989-2000) an agent has been mapped in each ecoregions.

	Alder Defoliators	Aspen Defoliators	Birch Defoliators	Cottonwood Defoliators	Willow Defoliators	Hemlock Defoliators	Larch Defoliators	Spruce Defoliators	Spruce Needle Aphid	Bark Beetles	Cedar Decline	Porcupine Damage	Spruce Rust	Windthrow
POLAR														
Arctic Tundra														
Brooks Range	1	-	-	-	-	-	-	-	-	4	-	-	2	-
Bering Tundra														
Seward Peninsula	-	-	-	-	2	-	-	-	-	3	-	-	-	-
Bering Taiga														
Ahklun Mts.	-	-	-	-	1	-	-	-	-	3	-	-	-	-
Nulato Hills	-	-	-	2	2	-	-	-	-	8	-	-	1	-
Yukon-Kuskokwim Delta	-	-	1	-	1	-	-	-	-	6	-	-	-	-
Bristol Bay Lowlands	-	-	-	-	1	-	-	-	-	1	-	-	1	-
BOREAL														
Intermontane														
Kobuck Ridges and Valleys	-	5	1	3	5	-	1	-	-	3	-	-	2	-
Ray Mountains	-	9	5	2	10	-	5	7	-	10	-	-	2	-
Davidson Mts.	-	1	1	1	4	-	-	-	-	5	-	-	-	-
Yukon-Old Crow Basin	-	4	3	2	11	-	1	2	-	11	-	-	3	-
North Ogilvie Mts.	-	2	1	-	7	-	-	-	-	2	-	-	1	-
Yukon-Tanana Uplands	-	8	4	2	7	-	5	8	-	11	-	-	1	-
Tanana-Kuskokwim Lowlands	-	9	8	6	10	-	10	7	-	12	-	-	4	-
Yukon River Lowlands	-	4	3	5	11	-	5	9	-	12	-	-	3	-
Kuskokwim Mts.	-	2	1	1	3	-	5	1	-	12	-	-	1	-
Alaska Range Transition														
Lime Hills	-	1	2	1	1	-	2	1	-	7	-	-	-	-
Alaska Range	-	8	1	5	6	-	1	2	-	12	-	-	1	-
Cook Inlet Basin	-	12	8	9	6	1	-	1	-	12	-	-	3	-
Copper River Basin	-	4	1	1	2	-	-	-	-	11	-	-	4	-
Coast Mountains Transition														
Wrangell Mountains	-	1	-	-	-	-	-	-	-	8	-	-	-	-
Kluane Range	-	1	-	-	-	-	-	-	-	2	-	-	-	-
MARITIME														
Aleutian Meadows														
Alaska Peninsula	-	-	-	-	-	-	-	2	-	10	-	-	-	-
Coastal Rainforests														
Alexander Archipelago	3	-	-	6	-	12	-	1	10	12	3	9	1	9
Boundary Ranges	7	-	-	9	-	9	-	5	2	12	1	5	-	4
Chugach-St. Elias Mts.	1	8	5	5	3	5	-	6	3	11	1	1	2	3
Gulf of Alaska Coast	-	1	1	10	4	8	-	7	3	12	2	2	2	5
Kodiak Island	-	-	-	-	-	-	-	1	1	-	-	-	-	-

- Agents mapped reflect the abundance of tree species that occur in each ecoregion; Maritime Coastal Rainforests have the greatest variety of damage agent types, polar ecoregions have the fewest.
- Hardwood and willow defoliators are most frequently mapped in the Boreal Intermontane and Alaska Range Transition regions.
- Of those ecoregions where forest damage has been mapped, bark beetles have been detected in every region except Kodiak Island. However, a sizeable spruce beetle outbreak occurred on Afognak Island (Kokiak Island region in the 1930.